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Authors: Tom Bultreys*, Wesley De Boever*, Luc Van Hoorebeke** and Veerle Cnudde*
Affiliations:

* Centre for X-Ray-tomography (UGCT), Dept. of Geology & Soil Science, Ghent University, Belgium

** Centre for X-Ray-tomography (UGCT), Dept. of Physics & Astronomy, Ghent University, Belgium

Presenting Author: Tom Bultreys
Email: Tom.Bultreys@ugent.be
Phone: 0032(9)264 4633

Contribution Title: Image-based multi-scale pore network models to investigate two-phase flow in carbonate rocks

Abstract (up to 250 words):
Over the last couple of years, algorithms have been developed to extract pore network models directly from 3D images of a rock's porosity. These network models have been used to simulate capillary pressure curves, (relative) permeabilities and electrical properties during drainage/imbibition cycles. However, the use of pore network models on rocks with very broad pore-size distributions remains a topic in need of further research, as the understanding of the multi-phase flow behaviour of such materials is of crucial economic and scientific importance.

We build a new type of two-scale network model which incorporates microporosity information without taking every individual micropore into account. We start from a micro-CT scan which is segmented into 3 phases (pore, solid and microporous voxels), and extract a maximal ball network (Dong and Blunt, 2009) from the porous voxels. The microporosity is clustered into 3D connected regions. Pores touching the same microporous cluster are connected by a new type of network element called micro-connections. These connections are assigned conductances based on the local contact surface areas between pores and microporous clusters, as well as on the continuum petrophysical properties of the microporosity it represents. We attempt to assess these properties with mercury intrusion and FIB/SEM experiments.

This study shows results of resistivity curves and relative permeability curves calculated during drainage of Estaillades, a carbonate rock. The results suggest that this is a promising method to simulate core-scale multi-phase flow behaviour of rocks with complex, multi-scale porosities. The work therefore fits in the conference topic "Multi-Scale".

References:

Dong, H., & Blunt, M. (2009). Pore-network extraction from micro-computerized-tomography images. *Physical Review E*, *80*(3), 036307

Preferred presentation platform: oral presentation